

A NEW FOSSIL SCALE INSECT
(HOMOPTERA: COCCOIDEA)
FROM CANADIAN AMBER

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Oligocene and Miocene ambers from the Baltic area and from Mexico have yielded more than 100 known specimens of fossil Coccoidea. However, insofar as they can be identified, these all appear to belong to extant genera. The only previously described Mesozoic coccid fossil, *Mesococcus asiatica* Becker-Migdisova (1959), is an impression, said to represent a wingless female or nymph, from an Upper Triassic deposit at Issik-Kul, Kirghiz, SSR, Soviet Union. From the published description and figure of that specimen, its assignment to the Coccoidea seems to be based upon rather inconclusive evidence as important structures, such as the antennae and mouth-parts, are not preserved.

The specimen described here is preserved in amber from Cedar Lake, Manitoba. This amber is almost certainly of Upper Cretaceous age (Carpenter, *et al*, 1937; Richards, 1966).³ The specimen is unquestionably an adult male coccid, and is in a relatively good state of preservation. The body and its appendages appear to be almost entirely intact, and the specimen is not obscured by any large external air bubbles, as in some Baltic amber coccids which I have examined. Parts of the specimen are somewhat distorted due to shriveling of the membranous portions of the integument. The venter of the head apparently is split or torn behind the ventromedial plate, and flap-like shreds of membranous integument extend beneath the head in this region. A pronounced flaw plane roughly perpendicular to the insect's body, intersects the specimen on the posterior part of dorsum of the thorax and partially obscures certain morphological details in that region. The entire venter of the insect is unobstructed, however. The left forewing extends posteriorly at a slight angle to the body, and most of the details of the wing are clearly discern-

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ible. The right forewing lies directly over the abdomen making details of the dorsum of the metathorax and abdomen difficult to see. The hind wings, which in male Coccoidea are absent or reduced to very small, linear or club-like hamulohalteres, are indistinguishable in this specimen, although possibly present but obscured by the flaw plane.

The comparative external morphology of adult male Coccoidea has been the subject of considerable research during recent years (Theron, 1958, 1960; Beardsley, 1968). Most of this work has involved study of the comparative morphology of the cephalic and thoracic sclerites in specimens which have been properly cleared and stained. Fortunately, the Cedar Lake specimen is well enough preserved that it has been possible to identify most of the integumental sclerites, thereby permitting comparison with the known adult males of extant Coccoidea. In the description which follows the terms used are largely those introduced by Theron (1958) which have been accepted, with slight modifications, by other students of male coccids.

The accompanying figures necessarily are somewhat diagrammatic. Because of distortion due to shriveling and the obscuring of certain structures by the dorsal flaw plane, it was necessary to observe all surfaces of the specimen from many angles, using different lens and light combinations, to properly delimit the integumental sclerites and other structures. It is quite possible that weakly developed sclerites which might have been seen had it been possible to clear and stain the specimen, have been overlooked.

Electrococcus, new genus

Coccoidea, presumably of the family Margarodidae (sens. lat.). Adult male characterized by small size, well-developed cephalic and thoracic sclerites, ten segmented antennae with the pedicel conspicuously enlarged, three pairs of moderately elongate slender legs and a pair of well-developed mesothoracic wings. Head well defined, separated from thorax by a distinctly constricted neck region. Ocular sclerites well developed, each bearing an anterior dorsoventral row of simple eyes, plus a single larval eye (stemma) laterally behind anterior row. With well-defined dorsomedial and ventromedial sclerites. Posterior margin of dorsum of head with a postoccipital ridge. Functional mouthparts absent; structure of tentorium not determined.

Mesothorax strongly sclerotized; with a convex prescutum separated from lateral margins of thorax by anteriolateral extensions of the scutum. Scutum without a mesal membranous area. Scutellum small, somewhat convex, approximately trapazoidal in shape, apparently separated from mesopostnotum by a moderately wide

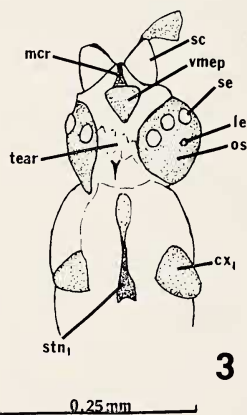
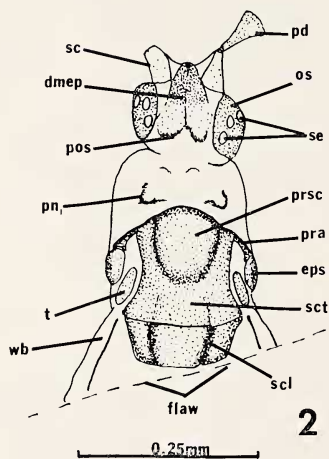
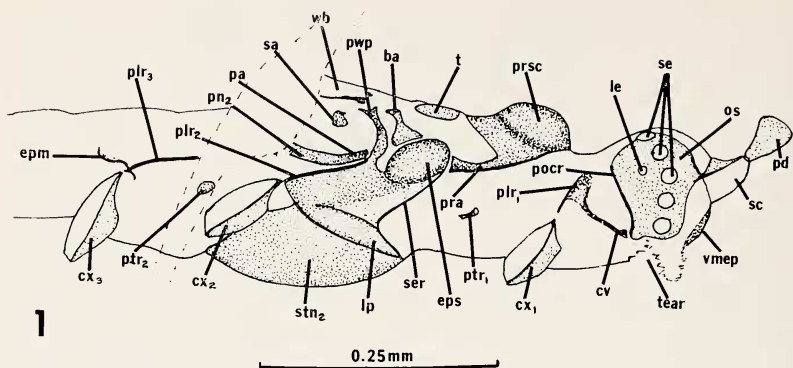


Fig. 1. *Electrocooccus canadensis* n. sp., lateral aspect of head and thorax. Fig. 2. Dorsal aspect of head and thorax. Fig. 3. Ventral aspect of head and prothorax.

membranous area. Mesosternum elongate, convex below, and rather strongly displaced posteriorly in relation to the tergites so that the mesopleurites are noticeably more inclined than in most other male Coccoidea. Sclerites of pro- and metathorax greatly reduced, as in other male Coccoidea. Two pairs of thoracic spiracular peritremes present.

Abdomen relatively elongate, slender; with eight discernible pre-genital segments which become progressively narrower posteriorly. Apex of abdomen bearing a moderately elongate, apically acute, sclerotized penial sheath with a slit-like ventral opening. Structure of aedeagus not determined. Dorsal abdominal tubular duct clusters or lateral pore pockets apparently absent. Abdominal spiracles not discernible.

Type of genus: *Electrococcus canadensis*, n. sp.

***Electrococcus canadensis*, n. sp. (figures 1-8)**

Length of specimen, excluding antennae 1.3 mm; length of fore-wing 0.9 mm.

Head distinctly separated from thorax by a markedly constricted neck region; lateral areas of epicranium occupied by pair of large ocular sclerites (os), each bearing an arcuate dorsoventral row of 5 simple eyes (se) anteriorly plus a single smaller larval eye (le) or stemma laterally; posterior margin of ocular sclerite thickened to form a postocular ridge (pocr), anterior margin of ocular sclerite slightly thickened above and below articulation point of antennal scape. Ocular sclerites broadly separated dorsally; dorsum of head with a definite dorsomedial sclerite (dmep) the anterior portion of which is strongly sclerotized, the posterior portion much less distinctly so; posterior margin of dorsomedial sclerite marked by a thickened postoccipital ridge (pos) which does not extend laterally to the ocular sclerites. Dorsomedial plate narrowed anteriorly, extending ventrally between antennae and onto venter of head as a narrow midcranial ridge (mcr), as far as the anterior margin of the ventromedial plate (vmep) below. Ventromedial plate approximately in form of equilateral triangle. A narrow bar-like median longitudinal sclerite of unknown relationship (possibly a cranial apophysis) on posterior portion of venter of head behind torn area. Antennae (fig. 4) about 0.54 mm. long; scape (sc) largely membranous except for longitudinal ridge-like thickening on inner face; pedicel and flagellar segments strongly sclerotized, pedicel (pd) large, trumpet-shaped; flagellar segments bearing a few scattered slender setae, and

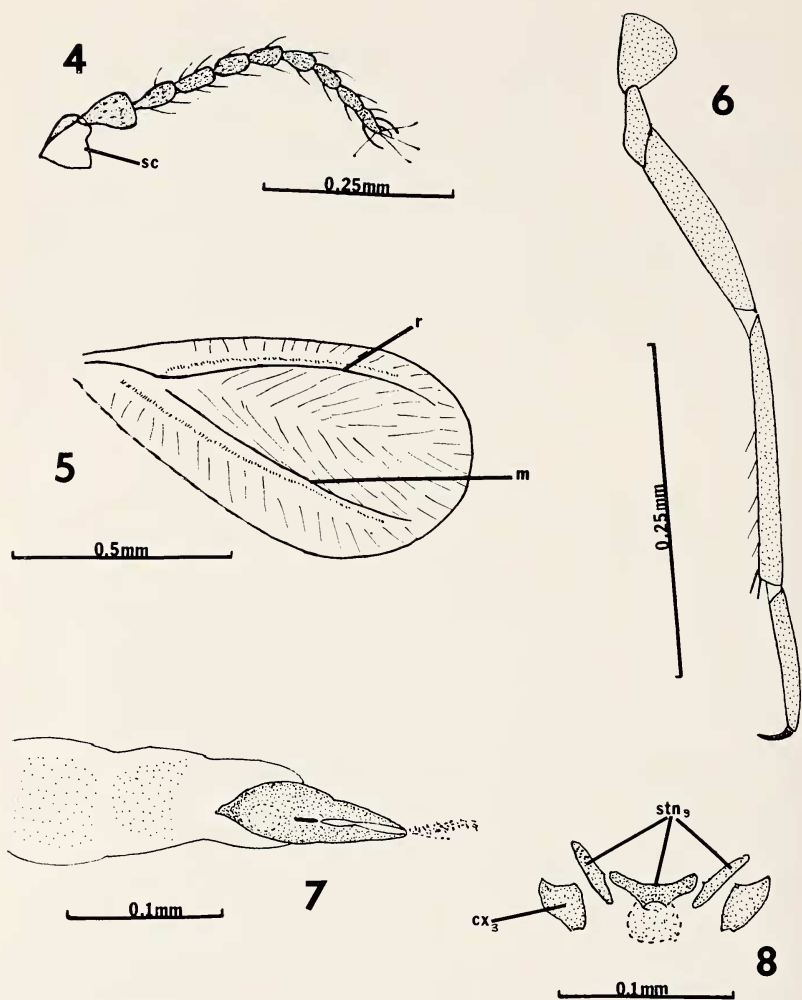


Fig. 4. Right antenna. Fig. 5. Left forewing. Fig. 6. Metathoracic leg. Fig. 7. Ventral aspect of posterior abdominal segments and penial sheath. Fig. 8. Venter of metathorax.

small dash-like reflective areas which may be sites of very short setae, or sensoria. Apical segment with 3 curved thickened digitiform setae and four long, slender, apically capitate setae.

Prothorax largely membranous; dorsum with a pair of small transverse postnotal sclerites (pn) with weak lateral anterior extension indicated; pronotal ridge apparently not developed. Propleural sclerites well defined; consisting of the propleural ridge (plr₁) and a elongate cervical sclerite (cv); these apparently not intimately fused at juncture. Anterior end of cervical sclerite apparently articulating with base of postocular ridge. Small sclerotized prothoracic spiracular peritreme (ptr₁) present in membranous area between forecoxa (cx₁) and mesepisternum. Prosternite (stn₁) well defined, narrow, elongate; anterior portion expanded into a small, nearly quadrate, less strongly sclerotized plate; posterior apex shallowly incised medially.

Prealare (pra) narrow, strongly reflexed, arising from anterio-lateral extension of scutum, possibly extending as a narrow thickened band along anterior border of scutal extension to sides of scutum; no evidence of separate triangular plate at apex of prealare. Tegula (t) relatively large and elongate. Basalare sclerite (ba) large and conspicuous; small subalare (sa) discernible in membranous area just below wing base. Mesopostnotum (pn₂), except for right side, largely obscured by flaw plane in type specimen. Postalare (antero-lateral arm of mesopostnotum) (pa) extending to base of pleural wing process (pwp). Mesopleural ridge (plr₂) extending almost horizontally forward from base of mesocoxa to presumed site of mesopleural apophysis just below base of pleural wing process. Mesepisternum (eps₂) well developed, with a large, oval, somewhat convex disc area dorsally; anterior part of episternum below disc weakly sclerotized; anterior margin marked by a narrow subepisternal ridge (ser). A narrow, well-defined lateropleurite (lp) present at base of episternum, apparently separated from it by a posterior extension of the subepisternal ridge. A small triangular sclerite, apparently the mesothoracic spiracular peritreme (ptr₂), behind base of mesocoxa. Mesobasisternite (stn₂) large, strongly sclerotized, convex, longer than wide; apparently not divided by a median longitudinal ridge. A pair of small, narrow, sublateral sclerites immediately behind basisternite may represent a mesospinasternite.

Metanotum not discernible in type specimen due to intersecting flaw plane. Metapleural ridge (plr₃) elongate, narrow, strongly inclined, extending anteriorly from base of hind coxa to margin of flaw plane. Hamulohalteres, if present, not discernible. Metepimeron

(epm) present, consisting of a narrow posteriorly directed postcoxal ridge and small attached sclerotized patch. A very short precoxal ridge also discernible at base of metapleural ridge. A small transverse mesal metasternite (stn_3) present (fig. 8); an indefinite dark area on its posterior margin may be the metasternal furca. A pair of poorly defined, narrow, sclerotized patches, on either side of the mesal metasternite, probably represent detached portions of that sclerite, similar to those of *Steingelia* (Theron, 1958).

Forewings (fig. 5) similar to those of modern male Coccoidea. Discernible venation includes only anterior radius vein (r) extending parallel to anterior margin, nearly to apex of wing, and media (m) extending approximately parallel to posterior margin, nearly to apex. A faint ridge-like thickening present just anterior and parallel to r and just behind and parallel to m. Wing surface with numerous fine, weakly developed fold lines, similar to, but less clearly defined than in *Matsucoccus* males (Beardsley, 1968). Legs (fig. 6) moderately long and slender; tibiae each with one or two conspicuous apical setae; tarsi apparently one-segmented; tarsal claws long, slender.

Abdomen dorsoventrally flattened, apparently largely membranous, except for venter of segments 3 to 8 which appear somewhat sclerotized. No dorsal or lateral tail-forming clusters seen. Penial sheath (fig. 7) apparently sclerotized dorsally only in area behind presumed site of anal opening. Ventral portion of sheath well sclerotized, apparently with a basal ridge and a slit-like longitudinal aperture; poorly defined dark area beyond apex of sheath possibly remains of aedeagus or endophallus.

The type specimen is in the Museum of Comparative Zoology, Harvard University (MCZ #6623).

RELATIONSHIP OF ELECTROCOCCUS TO EXTANT COCCOIDEA

Two major subdivisions of the Coccoidea are recognized by most coccid taxonomists; the more primitive archeococcids, (usually limited to the families Margarodidae and Ortheziidae) and the more specialized neococcids containing the remaining 10 or 12 generally recognized families (see Borchsenius, 1957). Among extant forms the morphologically least specialized adult males are those of the Ortheziidae and such margarodid subfamilies as the Matsucocinae and Margarodinae (Beardsley, 1968).

The *Electrococcus canadensis* male exhibits a much greater degree of morphological specialization than do those of the more primitive

Table I. Morphological features of *Electrococcus* compared with other male Coccoidea with eyes in dorsoventral rows.

	<i>Electrococcus</i>	<i>Pityococcus</i>	<i>Steingelia</i>	<i>Phenacoleachia</i>	<i>Puto</i>	<i>Kermes</i>	<i>Coccus</i>
Pedicel enlarged	+	+	—	—	—	—	—
Ocular sclerites not contiguous ventrally	+	+	—	+	—	—	—
Ventromedial plate present	+	+	+	+	—	—	—
Pronotal ridge present	—?	+	+	+	+	+	+
Scutum without mesal membranous area	+	+	—	+	—	—	—
Mesosternum undivided	+	+	—	+	+	+	—
Thorax strongly slanted	+	+	—	—	—	—	—
Tail-forming pore clusters absent	+	+	—	—	—	—	—
Penial sheath bifid apically	—	+	—	+	—	—	—
Abdomen evenly tapered	+	+	—	—	—	—	—

living archeococcids. Specialized features of the *Electrococcus* male include: 1) reduction of the compound eye to a single dorsoventral row of ommatidia; 2) the strong forward inclination of the thorax; 3) the development of broad anterior extensions of the scutum which enclose the prescutum laterally; 4) the absence of dorsal abdominal tubular duct clusters; and 5) small size.

The presence of a dorsoventral row of simple eyes in adult male Coccoidea is generally interpreted as stage of reduction intermediate between the complete compound eye typical of most male archeococcids and the isolated dorsal and ventral simple eyes which are the last remaining vestiges of the compound eye in the majority of male neococcids. Among extant Coccoidea, males of six well differentiated groups (families or subfamilies) have eyes of same general type of *Electrococcus*. Of these two are specialized margarodids; *Steingelia* (Steingelinae) and *Pityococcus* (Pityococcinae) (Theron, 1958; Beardsley, unpublished). Two additional groups; *Puto* (Putoidae) and *Phenacoleachia* (Phenacoleachiidae) are morphologically and cytologically primitive neococcids (Theron, 1960; Beardsley, 1962; Brown and Cleveland, 1968), while the two remaining groups, *Kermes* (Kermidae) and some genera of the family Coccidae (Giliomee, 1967), are somewhat more specialized neococcids.

In Table I, certain morphological features of the *Electrococcus* male are compared with those of other groups having eyes in dorsoventral rows. This table is based upon direct comparison of specimens in all groups, as well as on published information. Of the groups compared, only males of *Phenacoleachia* (Theron, 1962), *Steingelia* (Theron, 1958) and the Coccidae (Giliomee, 1967) have been described in adequate detail. The evidence suggests that the *Electrococcus* male is more similar to males of *Pityococcus* than to any of the others.

The structure of the cephalic and thoracic sclerites in *Electrococcus* indicates that it is the male of a specialized archeococcid or a very primitive neococcid. The several points of similarity between this specimen and males of *Pityococcus* have led me to conclude that *Electrococcus* is probably a specialized type of margarodid, possibly related to modern Pityococcinae.

The relatively high degree of morphological specialization in the *Electrococcus* male indicates that at least the archeococcids had already undergone considerable divergence before the end of the Cretaceous, and suggests that the original divergence of the ancestors of modern Coccoidea and Aphidoidea probably occurred relatively early in the Cretaceous, or even before.

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